Space Weather Technical Forecast

Issued on Sunday, 24 July 2022 at 01:25 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Ongoing risk of G1/Minor Storms from recent CME arrival. Slight Chance of R1/R2. Chance of Active electron fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low through the last 24 hours, with modest C-class flare activity, the majority of this activity has been in the last 12 hours. The strongest flare was a C3.6 flare at 23/2241 UTC from ex-AR3057 which has just rotated across the western limb. AR3063 in the northwest quadrant has faded, with the remaining five regions all appearing stable and relatively inactive. Three CMEs have been analysed over the last 24 hours, with none of these adjudged to have an Earth-directed component. A further apparent full halo CME has recently become discernible on satellite imagery, although a source region is not immediately obvious. A full analysis will be undertaken as soon as sufficient imagery is available.

Solar Wind / Geomagnetic Activity: The solar wind, observed at L1, started the period at elevated levels, around 550km/s, due to the existing high speed stream, but increased to around 675km/s at 23/0257 UTC due to a CME arrival, before declining back to 550km/s by 23/1330 UTC. A further shallower increase was then observed from 23/2045UTC, reaching 600km/s by 23/2330 UTC. Density started around average, but peaked at close to 20 ppcc, before declining to around average. A further slight increase was then observed in line with the increase in solar wind speeds. Total magnetic field strength increased from weak to strong levels at 23/0257 UTC due to the CME before decreasing to weak levels by around 23/1400UTC with a second, more modest increase to around 5nT from 23/2045 UTC. The north-south component, Bz, varied between +/-13nT due to the arrival of the CME, before becoming near-neutral from 23/1400UTC. The Bz, has since become weakly, but persistently, negative since 23/200UTC. The slight increase in these parameters may be due to a slightly denser portion of the CME. Phi angle has been predominantly negative (towards the Sun) through the period. Geomagnetic activity started Active, then increased to G1/Minor Storm levels between 23/0300-0600 UTC due to the CME arrival. Conditions have been Quiet to Unsettled since that time.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV), as measured by GOES16, was at background levels. High energy electron flux (greater than 2MeV) initially fluctuated sharply between background and moderate levels, but has been mainly moderate since around 23/1200 UTC, with a peak of 702 pfu at 23/1555 UTC. Electron fluence has followed a declining trend, and has remained well below the Active threshold, falling to 1.69e7 integrated pfu by 23/2100 UTC.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary
Solar Activity: Activity is expected to remain Low, with no significant or active regions on the visible disc.

Solar Wind / Geomagnetic Activity: The CME which arrived on 23 July is expected to affect the Earth through 24 and 25 July, especially in any period of sustained negative Bz. A high speed stream from a combination of coronal holes 01 and 02, is also affecting the Earth, with this likely to decline by day 3 (26 July). No further features are currently forecast to affect the Earth. Geomagnetic activity is expected to be mainly Unsettled through day 1, but with a further risk of Active or G1/Minor Storm intervals in any sustained periods of southward Bz. A return to mainly Quiet, with isolated Unsettled periods is forecast from day 3 (26 July).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is most likely to remain at Background levels. The high energy electron flux (greater than 2 MeV) is expected to vary between background and moderate levels initially, with an increasing risk of exceeding the high (1e3 pfu) threshold as the period progresses. Electron fluence is forecast to follow a generally increasing trend through the period, with a chance of exceeding the Active (1e8 integrated pfu) level by the end of the period.

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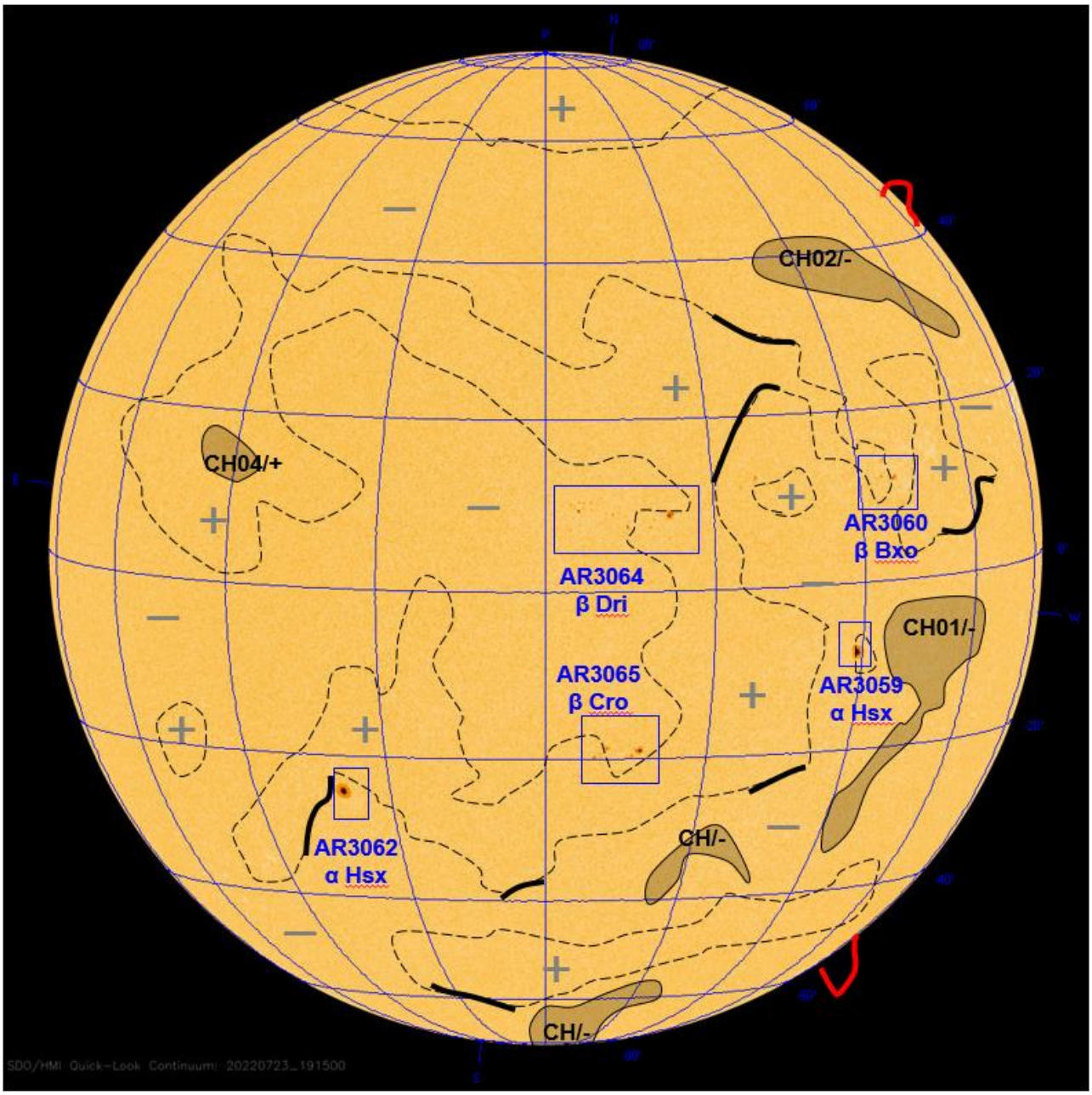
Figure 1. Solar Analysis Valid 23/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A full halo CME arrived at Earth early on 23 July, and although the effects of this quickly declined, there is a suggestion in the data that further storming is possible through 24 July. A slight chance of G1/Minor Storms is maintained through 24 July, with a decline into 25 July (day 2).

There is also an ongoing coronal hole high speed stream affecting the Earth, with speeds of 550km/s observed prior to the arrival of the CME. Speeds have now settled down to similar speeds, post-CME shock, demonstrating a continuing high speed stream influence. This effect is likely to continue through much of 25 July, but with a waning influence into day 3 (26 July).

Geomagnetic activity is expected to be mainly Unsettled through day 1, with a further risk of Active or G1/Minor Storm intervals in any sustained periods of southward Bz. A return to mainly Quiet, with isolated Unsettled periods is forecast from day 3 (26 July).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	20	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Figure 2: SOHO C3 imagery of recent full halo CME. This is currently being analysed for a potential Earth-directed component.

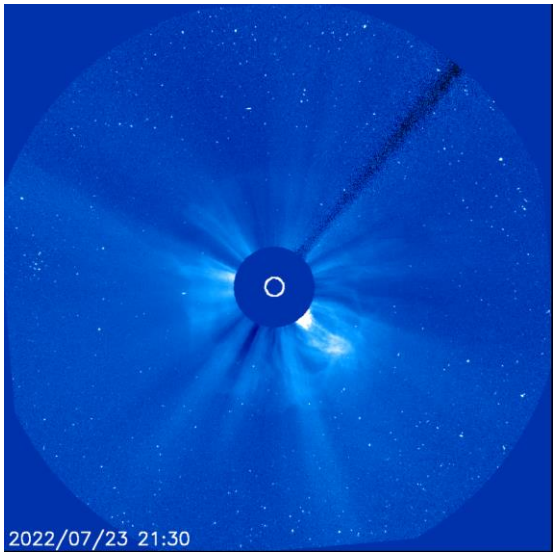

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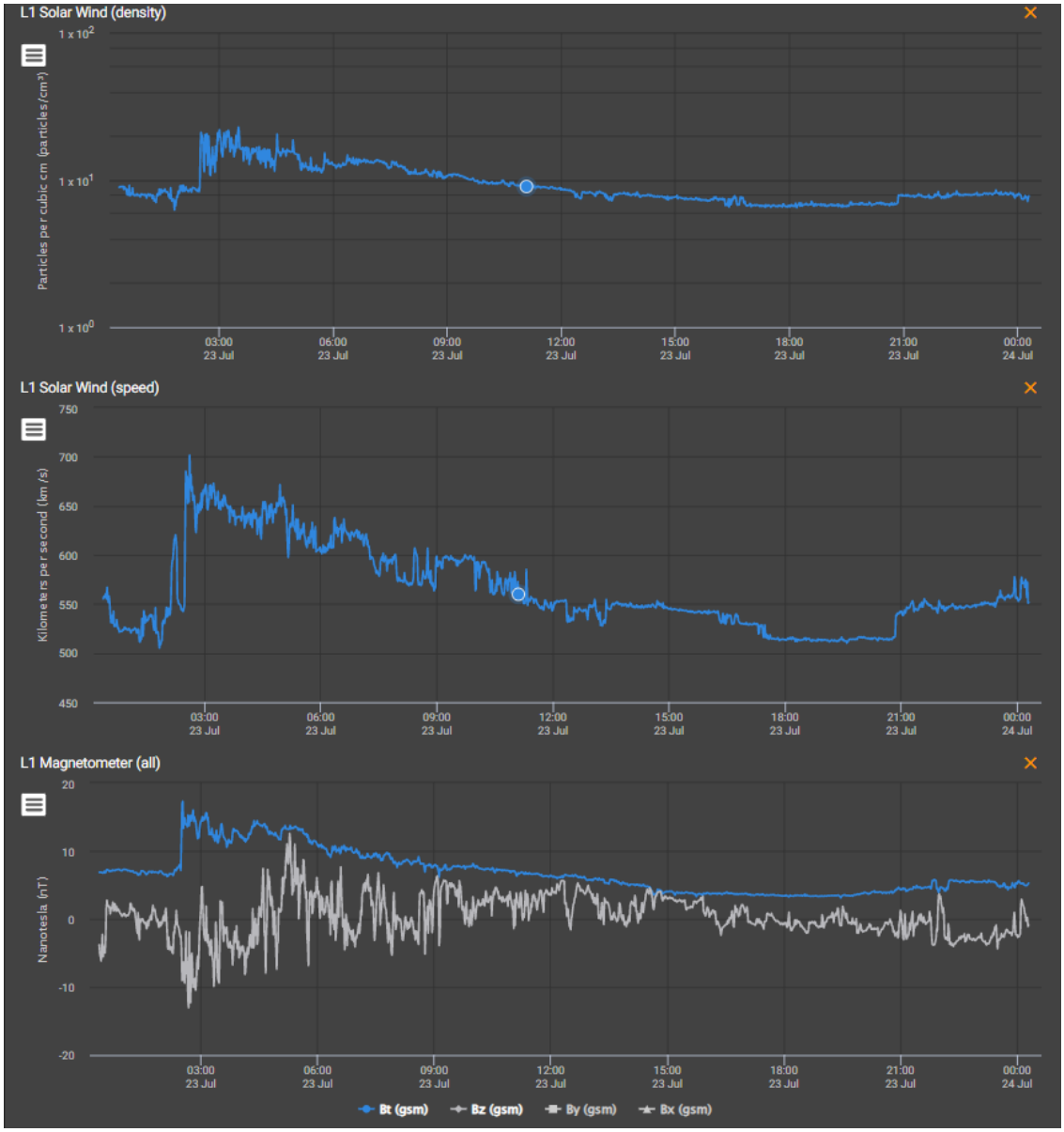
Figure 3: L1/DSCOVR solar wind parameters, showing the variations in solar wind parameters described in the text.



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Radio Blackouts - X-Ray Flares:

Solar activity has been Low over the last 24 hours, with modest C-class flare activity, although the frequency of C-class flaring has increased in the last 12 hours, suggesting a possible development in activity levels.

Two sunspots have either faded or rotated off the disc in the last 24 hours. In comparison to the loss of these regions, analysis of the far side and possible returning regions suggests an increase in activity through the next four days, especially towards the end of the forecast period. Although the probabilities have not been adjusted for this potential increase, due to a lack of confidence, this will be monitored using the limited advance images from STEREO A EUVI imagery.

Solar activity is expected to remain Low, with a slight chance of Moderate activity.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at background levels. As most regions are small and relatively magnetically simple, the risk of a proton enhancement is very low.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) is expected to vary between background and moderate levels through day 1 (24 July). The peak electron flux is expected to continue to increase through the period, with an increasing chance of exceeding the high (1e3pfu) threshold through days 1 and 2. Persistently high levels are then possible on days 3 and 4 as the high speed stream eases and radiation belts return to their natural orbits. There is low confidence in this forecast however, as it is dependent on generally muted geomagnetic activity.

Electron fluence values are expected to follow an upward trend through the next four days, with a chance of exceeding the Active (1e8 integrated pfu) threshold through days 3 and 4.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	10	20	30	30
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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